IDS Baseline and Work Plan

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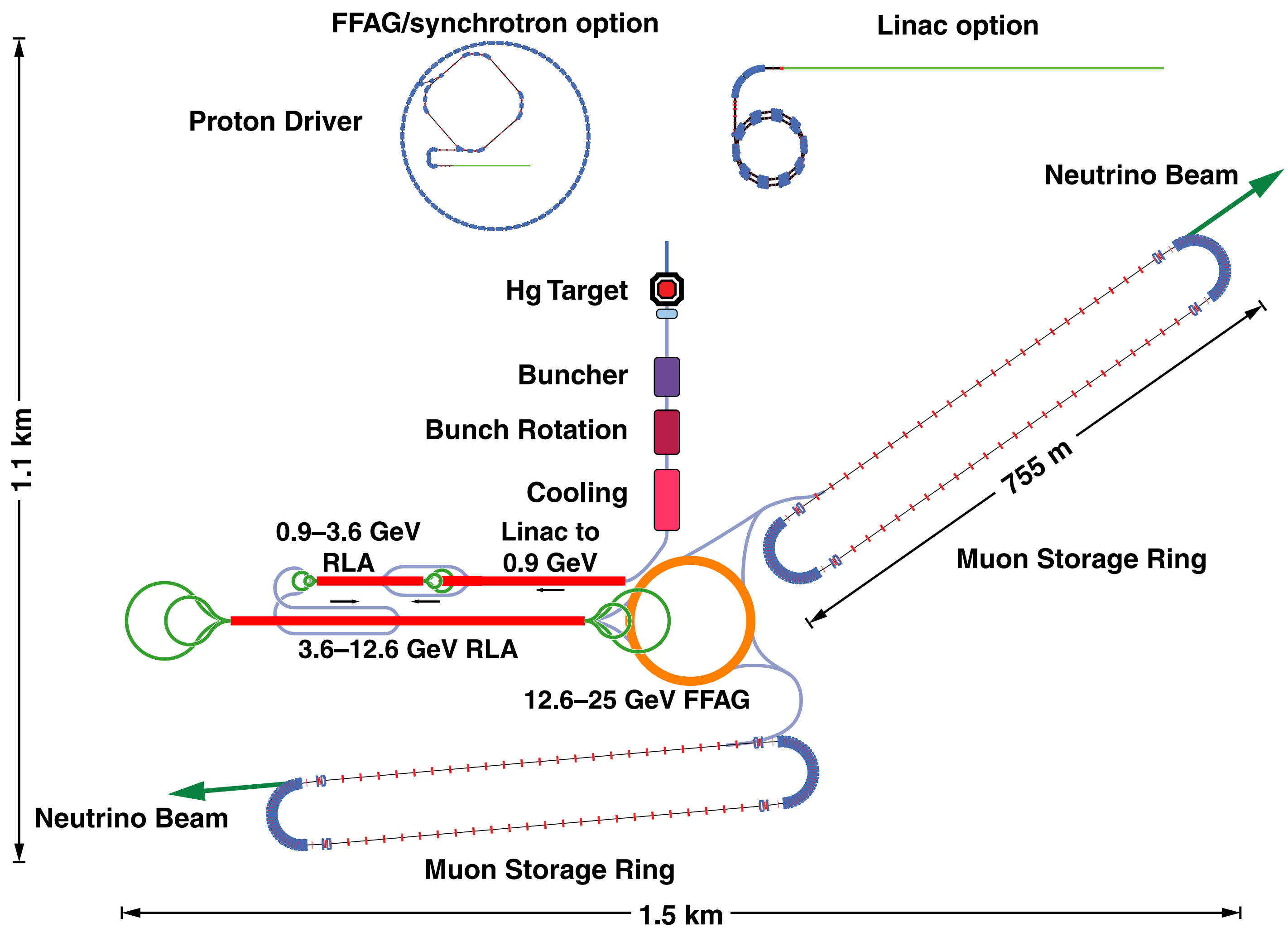
Outline

- Baseline Specification
  - Overall goals
  - Subsystem specifications
- Work plan

Baseline Overall Goals

- 25 GeV total energy muon beam
- 10^{21} decays per 10^7 second year toward target
- Angular divergence below $0.1/\gamma$
- Two baselines
    - 3000–5000 km
    - 7000–8000 km

Baseline
IDS Accelerator Systems



Baseline Proton Driver

- 4 MW proton power
- Energy range 5–15 GeV
- 50 Hz repetition rate
- 3 bunches per pulse
  - Arrive within 40 μs, separated by $\geqslant$ 17 μs
- 1–3 ns RMS bunch length
- Bunch structure important to target, acceleration, and storage ring

Baseline Target

- Liquid Hg jet
- Velocity 20 m/s
- Jet gives limitations on proton pulse structure
  - Proton bunch structure affects acceleration and storage ring designs
  - MERIT results will indicate what proton bunch structure is possible

Baseline Front End

- Based on US Study IIb
- 201.25 MHz train, average momentum 220 MeV/*c*
- “Neuffer” phase rotation and bunching
  - Many different cavity frequencies
- Modest amount of cooling
  - Increase muons within acceptance
  - 30 mm normalized trans., 150 mm long.

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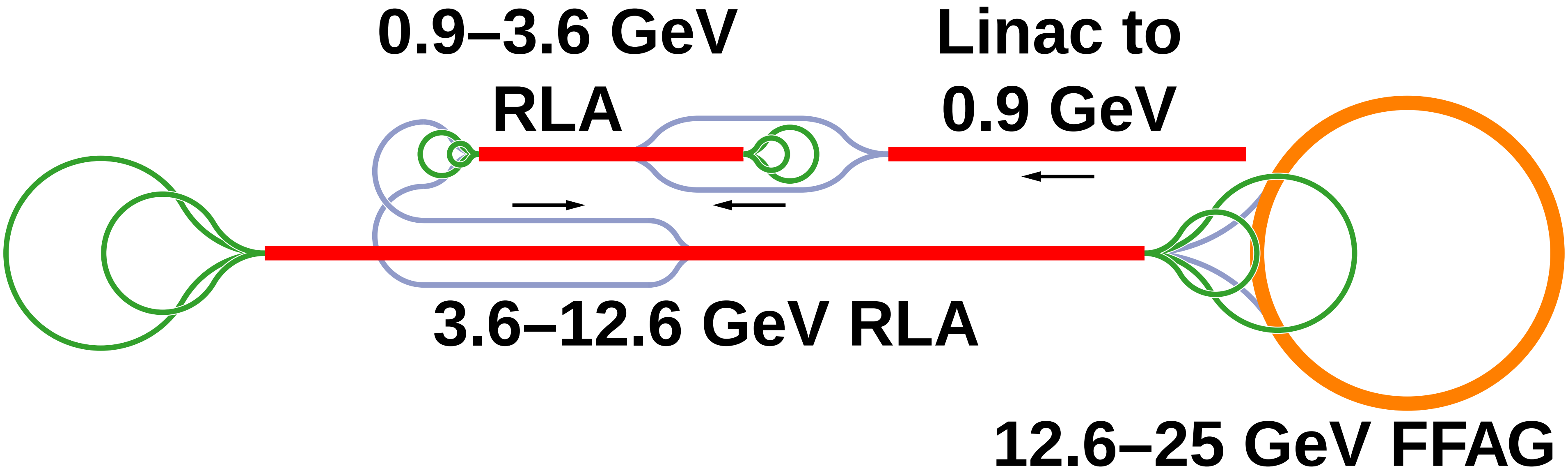
Baseline Front End

- Current design: high magnetic fields on cavities
- Experimental results indicate maximum gradients lower when magnetic fields present
- Must re-design front end considering this
  - Need more precise experimental results

Baseline Acceleration

- Accelerate cooled beam to 25 GeV
- Four stages, maximize efficiency
  - Linac
  - Two dogbone RLAs
  - Linear non-scaling FFAG
- All use 201.25 MHz SCRF, 15–17 MV/m

Baseline Acceleration



Baseline Acceleration

- Proton bunch structure affects design
- Beam loading when making many passes
- Different trains gain different energy
- At least 150–200 μs for all trains
  - Depends on number of RLA/FFAG passes
  - Longer than time allowed by target
    - MERIT results may lengthen allowed time
- May require complex RF manipulations to fix

Baseline Storage Ring

- Two racetrack rings
- Both rings capable of two simultaneous signs
- 100 ns gap between bunch trains
- Circumference can hold 6 trains plus gaps
  - Three trains, two signs

Work Plan
Proton Driver

- Design of at least one proton driver meeting IDS NF requirements
  - 4 MW, 3 bunches, 50 Hz very challenging
  - Sufficient design and simulation to get general agreement that system is possible
- Multiple proton drivers can be considered
  - Cost and performance comparison
  - Sufficient information for comparison needed
  - Avoid degenerating to lab-vs-lab

Work Plan
Target

- Analysis of MERIT data
  - Determine proton bunch train length possible
  - Maybe other critical parameters
  - Drives design parameters for other systems
    - Acceleration
    - Proton driver
- Engineering of target infrastructure

Work Plan
Front End

- Bunching, phase rotation, cooling
- Experimental results relating magnetic fields on cavities and achievable cavity gradients
- Re-design of front end based on field limitations
  - Current designs probably have too much magnetic field at cavities

Work Plan
Acceleration: Linac

- Pre-accelerator linac design ***complete***
- Able to accelerate from cooling energy
  - No expensive warm acceleration
- Still needs tracking and analysis

Work Plan
Acceleration: Dogbone RLAs

- Injection system
- Full lattice design
  - Linear lattice design (linac and arcs)
  - Chromatic correction in arcs
- Engineering of switchyard and arc crossings
- Transfer lines
- Tracking and analysis

Work Plan
Acceleration: FFAG

- Lattice design
  - Done, but will be revised
- Injection and extraction
  - Preliminary studies done, still don't have a working system
- Transfer lines
- Tracking and analysis

Work Plan
Storage Ring

- Lattice design for 25 GeV rings
- Injection
- Tracking and analysis
  - Neutrino flux distribution

Work Plan
Overall System

- Engineering and cost estimate
  - Get estimate of system cost
  - Information for cost and performance optimization
    - Front-end, especially cooling
    - Acceleration choices

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Potential Pitfalls and Alternatives

- Some potential problem areas
  - Proton driver with compatible bunch structure
  - Cavities in magnet fields in front end
  - Successfully accelerating a beam with efficient systems

Potential Pitfalls and Alternatives

- If any of these give problems that can't be solved, significant re-design may be needed
  - Different target if proton driver problematic
  - New method for bunching and phase rotation
    - Probably more expensive
  - Other (more expensive?) acceleration options
    - E.g., scaling FFAGs